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A turbulent channel flow numerically solved at $Re_\tau = 180$ is studied through a complex network-based approach. By combining graph theory and statistical physics, complex networks theory recently emerged as a powerful tool to analyze complex systems, in particular to spatially characterize turbulent flows [1,2]. In this work, portions of volume of the physical domain are associated to the nodes of the network. Links between pairs of nodes, (i, j), are active if their correlation coefficient, $C_{i,j}$, based on the streamwise velocity is (in modulus) above a suitable threshold. By doing so, the strongest kinematic inter-relations are highlighted and the spatial information of the correlation is preserved. The importance of nodes in the domain is evaluated through the *volume-weighted connectivity*, VWC, which quantifies the fraction of volume connected to a node. Accordingly, $VWC(i)$ represents the fraction of volume strongly correlated with the domain location associated to i. Nodes with high values of VWC are the *hubs* of the network and they tend to cluster into streamwise-elongated regions of hubs, RoHs (see Fig. 1). By focusing on high-VWC nodes, the network analysis reveals the presence of a high recurrence of *teleconnections*, that is long-range links between distant locations. Therefore, teleconnections represent distant parts of domain with similar kinematic information. Specifically, teleconnections mainly appear between near-wall regions and they are associated with the temporal persistence of coherent patterns, namely high- and low-speed streaks.

The proposed network-based approach provides a versatile and powerful framework to study turbulent flows with different levels of detail, ranging from a global to a local scale. Based on the observed findings, the current approach can pave the way for an enhanced spatial interpretation of the turbulence dynamics and for a systematic network-based investigation of turbulence.

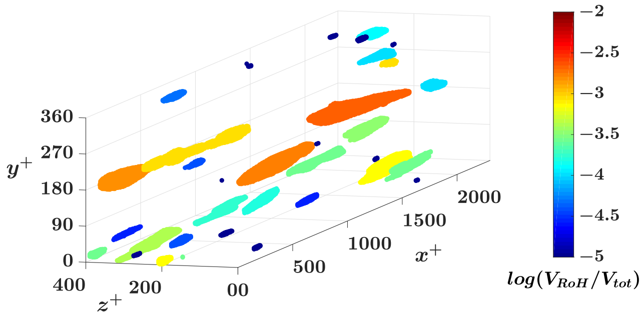

Figure 1: 3D view of the regions of hubs, RoHs. Colors indicate the fraction of volume occupied by each RoH.

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[2] Taira et al., *J. Fluid Mech.* **795**,R2 (2016)